DRAFT – REVISION 2
STORMWATER QUALITY CONTROL PLAN
BAREC PROJECT
SANTA CLARA, CALIFORNIA

Prepared For: SummerHill Homes

Prepared By: David A. Friedland, P.E.

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1. EXECUTIVE SUMMARY

The proposed development of the 17-acre project site in Santa Clara is required to comply with recently-promulgated regulations involving the reduction of pollutant loadings in stormwater runoff. This reduction in post-construction stormwater runoff pollutant loading is required by the City's NPDES permit and Provision C.3 of that permit, and includes analysis of both runoff volume controls and runoff treatment controls. The required reduction in pollutant loadings can be achieved through the use of Best Management Practices (BMPs), which include a variety of structural and non-structural site planning and design features. For the proposed project, a landscape-based treatment method is proposed as the key feature for pollutant reduction, consisting of grass/vegetated swales; other BMPs could also be selected during final project design. Swales are vegetated earthen channels that convey stormwater and remove pollutants, and when not holding water, appear as typical landscaped area. The landscape-based treatment methods, combined with additional "good housekeeping" measures, would substantially reduce the pollutant loading of stormwater runoff from the project site, and comply with pertinent regulatory requirements.

2. SETTING

2.1 PHYSICAL SETTING

The 17-acre proposed project site is currently undeveloped, having been historically used for agricultural research, with development limited to a few greenhouses located near the northeast corner of the site. The site is relatively flat, sloping toward the northwest, with elevations ranging from approximately 120 to 125 feet[1].

The site is located within the "West Valley Watershed", and stormwater runoff drains west through buried pipelines to a 13' by 15' box culvert located beneath the San Tomas Expressway[2]. Storm drainage subsequently flows north underneath the San Tomas Expressway for approximately three miles, to the point where the concrete channel emerges and joins Saratoga Creek near Monroe Street, where it continues on to San Tomas Aquino Creek, Guadalupe Slough, and the South San Francisco Bay. Thus, storm drainage from the site flows through hardened, engineered channels all the way to South San Francisco Bay.

The project site overlies the Santa Clara Groundwater Basin, which has an aerial extent of approximately 240 square miles and a total storage of approximately three million acre-feet. Groundwater levels beneath the site would be expected to vary seasonally and with the hydrologic cycle, with recent estimates at approximately 15 to 50 feet below ground surface[3].

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[1] Danny Raymond, HMH Engineers, personal communication, May 2004.

[2] City of Santa Clara, "Block Book", Storm Drain City Index.

[3] Eric Olsen, SCVWD Groundwater Management Unit, personal communication, May 2004.

2.2 REGULATORY SETTING

The major federal legislation governing water quality is the Clean Water Act, as amended by the Water Quality Act of 1987. The U.S. Environmental Protection Agency (EPA) is the federal agency responsible for water quality management nationwide.

The State of California's Porter-Cologne Water Quality Control Act provides the basis for water quality regulation within California; the Act assigns primary responsibility for the protection and enhancement of water quality to the State Water Resources Control Board (SWRCB), and the nine Regional Water Quality Control Boards. The SWRCB provides state-level coordination of the water quality control program by establishing state-wide policies and plans for the implementation of state and federal laws and regulations. Each Regional Water Quality Control Board (RWQCB) adopts and implements a water quality control plan ("Basin Plan") that recognizes the unique characteristics of each region with regard to natural water quality, actual and potential beneficial uses, and water quality problems. The RWQCB implements the Basin Plan by issuing and enforcing waste discharge requirements to control water quality and protect beneficial uses.

The project site is within the "West Valley Watershed", which drains to South San Francisco Bay, and is within the jurisdiction of the San Francisco Bay Regional Board (Region 2). The RWQCB has established beneficial uses that must be protected from pollution and nuisance as a result of waste discharge. While no beneficial uses have been formally designated for San Tomas Aquino Creek, the following beneficial uses have been established for South San Francisco Bay:

- Commercial and Sport Fishing (COMM);
- Estuarine Habitat (EST);
- Industrial Service Supply (IND);
- Fish Migration (MIGR);
- Navigation (NAV);
- Preservation of Rare and Endangered Species (RARE);
- Water Contact Recreation (REC-1);
- Non-Contact Water Recreation (REC-2);
- Shellfish Harvesting (SHELL);
- Fish Spawning (SPWN) (potential); and
- Wildlife Habitat (WILD).

In addition, the project site overlies the Santa Clara Valley Groundwater Basin, which has the following beneficial uses:

- Municipal and Domestic Supply (MUN);
- Industrial Process Supply (PROC);
- Industrial Service Supply (IND); and
- Agricultural Supply (AGR).

The RWQCB regulates waste discharges to protect beneficial uses through the National Pollutant Discharge Elimination System (NPDES) Permit process. NPDES Permits typically establish Waste Discharge Requirements (WDRs), which include discharge prohibitions, effluent limitations, receiving water limitations, and other provisions intended to protect the beneficial uses of the receiving water body.

The City of Santa Clara is a member of the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). In 2001, the Regional Board re-issued WDRs under the NPDES program for the discharge of stormwater runoff (NPDES Permit No. CAS0299718, Regional Board Order No. 01-024), through the implementation of a Storm Water Management Plan (SWMP), which describes a framework for management of stormwater discharges.

The Urban Runoff Management, Comprehensive Control Program section of the Basin Plan requires dischargers to address existing water quality problems and prevent new problems associated with urban runoff through the development and implementation of a comprehensive control program focused on reducing current levels of pollutant loadings to storm drains to the maximum extent practicable. The City is responsible for complying with Basin Plan requirements via the implementation of the SWMP.

Order No. 01-124 has been amended to include Provision C.3, concerning new and redevelopment performance standards to address post-construction impacts on stormwater quality. Provision C.3 calls for enhancement of the performance standard to increase the implementation effectiveness, primarily by:

- setting volume- and flow-based hydraulic sizing criteria for stormwater treatment measures;
- setting minimum sizes of new development and redevelopment projects which must employ the treatment measures;
- creation of a program to assure the adequate operation and maintenance occurs;
- creation of standards for source control measures and site design measures which can lead to reduced impervious surfaces for a given equivalent land use; and
- requires that the Dischargers develop a process and criteria to limit changes in the runoff hydrograph for new and redevelopment, where those changes could have a harmful effect on downstream beneficial uses.

3. IMPACTS

3.1 OVERVIEW OF PROPOSED PROJECT

The proposed project involves the development of the 17-acre site for residential and senior housing land uses. The western 11 acres of the site would be used for residential land use, including up to 110 homes on 10 acres, plus a 1-acre public park. The eastern 6 acres would be used to construct a senior housing facility. For the residential (western) portion of the project, impervious surfaces would total approximately 6.34 acres, or 58 percent; a breakdown of these impervious surfaces is presented in Table 1. For the senior housing (eastern) portion of the project, impervious surfaces would total approximately 2.75 acres, or 46 percent, as detailed in Table 2. Overall, approximately 53 percent of the 17-acre project site would be covered with impervious surfaces.

Table 1: Estimate of Impervious Area Types, Residential (Western) Portion

Land Use Type	**Impervious Area (square feet)**
Rooftops – Perimeter Lots	62,568
Rooftops – Internal Lots	82,436
Walkways	5,200
Driveways	25,400
Public Streets	100,500
TOTAL	276,104 (6.34 acres; 58%)

Source: HMH Engineers

Table 2: Estimate of Impervious Area Types, Senior Housing (Eastern) Portion

Land Use Type	**Impervious Area (square feet)**
Rooftops	58,417
Roadways/Parking Areas	48,487
Garden Walkways	12,960
TOTAL	119,864 (2.75 acres; 46%)

Source: Harman & Colliver

3.2 STORMWATER QUALITY IMPACTS

Implementation of the project would result in an increase in impervious surfaces at the site, including rooftops, streets, parking lots, driveways, and walkways. Such development would result in increased pollutant loadings in stormwater runoff from rooftops and other impermeable surfaces, as well as from automobile-related contaminants. In addition, landscaping areas could result in an incremental increase in surface water contamination if additional pesticides, herbicides or chemical fertilizers are introduced. Ongoing activities associated with the future build-out of the site could therefore contribute non-point source pollutant loadings, which could potentially result in adverse impacts to water quality in San Tomas Aquino Creek and South San Francisco Bay.

3.3 STORMWATER VOLUME IMPACTS

Future development of the project site would result in an increase in storm water runoff volumes from the site because the project site is currently undeveloped, consisting largely of bare soils previously used for agricultural research. The discharge from the site is a function of the rainfall intensity, the runoff coefficients and the tributary drainage area. In the pre- and post- development conditions, the rainfall intensity and tributary drainage area will be the same. The variable will therefore be the runoff coefficients, which are dependent upon the amount of impervious surfaces. The runoff coefficient for the existing site is estimated at approximately 0.2. The proposed development would result in approximately nine acres, or 53 percent of the site, consisting of impervious surfaces with a runoff coefficient of 0.95, with the remainder of the site estimated at approximately 0.15, for a weighted average of approximately 0.57; this value will need to be confirmed during final design. Therefore, the post-development stormwater discharge from the site is expected to increase, as compared to existing conditions.

The residential (western) portion of the project site will drain toward the northwest, connecting to a 36-inch storm drain at the intersection of Forest Avenue and North Henry Avenue. Storm drainage will flow west in this underground culvert and discharge to a 15' by 13' box culvert located beneath the San Tomas Expressway, where drainage will flow north to San Tomas Aquino Creek, Guadalupe Slough, and the South San Francisco Bay. Storm drainage from the senior housing (eastern) portion of the site will discharge to the existing storm drainage system in North Winchester Boulevard, where it will flow north to Pruneridge Avenue, then west to the box culvert beneath the San Tomas Expressway, and then north to the South San Francisco Bay.

The project is required to comply with Provision C.3 of the City's NPDES Permit (No. CAS0299718). Under Provision C.3, post-development peak stormwater runoff discharge rates and durations cannot exceed pre-development rates and durations if the increased peak stormwater discharge rates and/or durations would result in increased potential for erosion or other adverse impacts to designated beneficial uses. However, this requirement does not apply to projects that discharge stormwater runoff into creeks or storm drains where the potential for erosion is minimal, including discharges to creeks that are concrete-lined or significantly hardened to their outfall in San Francisco Bay, as well as construction of infill projects in highly developed watersheds.

Based on these criteria, no reduction in stormwater runoff volumes would be required due to Provision C.3 because the potential for the proposed project to result in increased erosion in San Tomas Aquino Creek is considered minimal; the creek consists of a concrete box culvert, which is not subject to substantial erosion. However, insofar as the local storm drainage system may be unable to accommodate the increased runoff that would result from the proposed project, on-site detention of stormwater would be helpful in reducing stormwater infrastructure impacts; this topic is addressed in a separate report prepared by HMH Engineers.

4. MITIGATION MEASURES

4.1 STORMWATER QUALITY

OVERVIEW

The project shall comply with Provision C.3 of the City's NPDES Permit (No. CAS0299718). The project would be considered a "Group 1 Project" under Section c. of Provision C.3; as such, the proposed project would be required to design and implement stormwater treatment BMPs to reduce stormwater pollution to the maximum extent practicable. Provision C.3, Section d., Numeric Sizing Criteria, shall be used to size the stormwater quality control facilities. Implementation of BMPs to reduce the pollutant loading of the stormwater that is generated on-site to the maximum extent practicable shall be incorporated into the overall site design and construction effort.

A wide variety of stormwater management techniques are available to reduce the volume and improve the quality of runoff (BASMAA, 1999; WEF 1998). There are two basic categories of treatment measures that address the permit requirements, consisting of volume-based controls that employ retention/detention methods, and flow-based controls that rely on water movement through filtration devices or systems; these can be used alone or in combinations to treat and/or divert urban runoff before it enters the City's storm drainage system. A summary of the most appropriate BMPs for the BAREC project site follows.

Grass/Vegetated Swales (Flow-Based)

Grass/vegetated swales are vegetated earthen channels that convey stormwater and remove pollutants, and can serve as an alternative to lined channels and pipes. When swales are not holding water, they appear as typical landscaped area. Pollutants and water are filtered by the grass and vegetation, and removed by infiltration into the soil. Through filtering through the vegetation and settling, swales provide good removal of suspended solids and the pollutants adsorbed onto the solids, including nutrients, heavy metals, and oil and grease. Dissolved constituents may also be removed through chemical or biological mechanisms mediated by the vegetation and the soil. Some infiltration occurs through the underlying soil cover, but that is not the primary purpose or mode of treatment.

Stormwater Planter Boxes (Flow-Based)

Stormwater planters could be used to treat runoff from building roof downspouts or sheet flow from plazas and paved areas. The runoff briefly floods the surface of the box, and then percolates through an active soil layer to drain rock below. These planters are typically located adjacent to a building, made of concrete, stone, or other durable material, and are at least 18 inches wide, with a length dependent upon the site and building landscape architecture. Planters contain approximately 18 inches of sandy loam topsoil, underlain with filter fabric followed by 12 inches of pea gravel, and should have a minimum infiltration rate of 5 inches per hour. Additionally, approximately 12 inches of freeboard reservoir space should be provided above the soil surface to accommodate heavy rainfall without overtopping. A downspout conveys stormwater to the planter box, while a perforated pipe underdrain acts to convey the stormwater that has percolated through the box to the main storm drain system. Irrigation is required to maintain the viability of plantings during the dry season.

Mechanical Devices (Flow-Based)

These controls include sand (or other media) filters to treat runoff, oil and water separators designed to remove petroleum compounds, grease, sand, and grit, and other proprietary devices. Filters typically include a settling basin followed by a sand filter, and include an overflow or bypass to prevent upstream flooding; these facilities require frequent maintenance to prevent clogging. Oil and water separators are typically used in areas where high concentrations of oil occur, such as bulk petroleum storage and refinery facilities; considering the generally low concentration of oil in stormwater, these devices would not be appropriate for this site. A number of manufacturers provide proprietary devices to mechanically remove pollutants from stormwater. These devices are generally contained in vaults constructed below-grade, and can remove suspended solids and petroleum hydrocarbons in a relatively small area. Mechanical devices are typically more appropriate as retrofits to existing developments, where few options exist.

Wet Ponds (Volume-Based)

Wet ponds are permanent pools of water that detain and treat stormwater runoff. They can be enhanced by designing a forebay to trap incoming debris and sediment, and by establishing a fringe wetland at the pond edge to increase pollutant removal and enhance the esthetic, economic, and habitat value of the pond. Surface area would be approximately 1% of the drainage area, and volume would be sized to store 0.5" to 1.0" of runoff from the drainage area. While the site designers may desire such a permanent pool of water as an aesthetic landscape feature, this would likely result in higher capital and maintenance costs, as compared to grass/vegetated swales (described above), and is therefore not recommended at this time.

Dry Ponds (Volume-Based)

Extended detention (dry) ponds store water during storms for a short period of time (from a few hours to a few days), and slowly discharge the stored water. These ponds are dry between storms, and do not have a permanent pool of water. These facilities can be used for both pollutant removal and stormwater detention, and can serve dual uses, serving as recreation or open space areas when not holding water. For the proposed project, the only locations for such a facility would be within the "public park", "landscaped open space", or within the senior housing gardens.

Infiltration (Volume-Based)

These treatment controls capture runoff and provide treatment by transferring surface runoff to the groundwater regime, thereby filtering out pollutants via the soil matrix. In general, use of infiltration is limited by the infiltration rate of the soils, high groundwater levels, or steep slopes. For this project, the most appropriate use of infiltration would be constructing a dry well or infiltration trench to infiltrate roof runoff, whereby soils are excavated and backfilled with gravel, with the sides wrapped in a permeable filter fabric; a perforated pipe can also be included within the gravel-filled trench. These facilities should be located at least 10 feet from the building to protect foundations. The suitability of infiltration as a stormwater management technique is dependent upon the infiltration rate of the local soils.

RECOMMENDED BMPS – SENIOR HOUSING (EASTERN) PORTION

For the senior housing (eastern) project of the project site, landscape methods would be the most appropriate because of the relatively large size of the overall project, the relatively high percentage of the site dedicated to landscaping, the generally flat topography of the site, and the fact that all stormwater runoff is transported to a storm drain pipeline network that discharges to the South San Francisco Bay. Landscape methods for stormwater quality control combine site engineering (grading and drainage) with landscape architecture; grass/vegetated swales would be the most feasible.

Swales require a minimum of approximately 1,200 square feet per acre of impermeable surface[4]; thus, for the proposed senior housing portion of the project (which includes a total of approximately 2.75 acres of impermeable surfaces), swales would occupy a minimum area of approximately 3,300 square feet. It is recommended that the swales be sized to retain/treat approximately 0.5 inch[5] of rainfall on the site, which represents a total volume of approximately 5,000 cubic feet. The swales shall not be used to treat sediment-laden runoff from the active construction site.

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[4] Source: *Start at the Source*, Bay Area Stormwater Management Agencies Association, 1999 ed.; p 139.

[5] Source: *Stormwater C.3 Guidebook*, City of Milpitas, September 2003; p 42-43.

While the exact locations of these swales are not available at this stage of project design, there appears to be adequate room on the site for these features, adjacent to roadways and parking areas, and otherwise integrated into the landscaping plans. Multiple swales may be necessary to treat all runoff from the site, but can include parking lot medians and perimeters of impervious pavements.

It is recommended that all swales be designed and constructed to drain within 48 hours of a storm event in order to minimize the potential for vectors, including mosquitoes. To accomplish this design criterion, a fabricated soil bed shall be installed into the channel bottom. Soils would consist of a sand/soil mix to ensure permeability, with an underdrain system installed under the soil bed. The underdrain system is typically created by a gravel layer that encases a perforated pipe. Additional stormwater treatment is accomplished by this design, and the treated stormwater is then conveyed to the storm drain system.

Both grass swales and vegetated swales could be used, depending on the location. Grass swales are planted with turf grasses, and move water more quickly than vegetated swales, which are planted with bunch grasses or shrubs. Swales are typically designed as trapezoidal channels, while filter strips are typically designed with either v-shaped or parabolic cross-sections. Pollutant removal increases with increasing residence time of water in the swale. The optimum longitudinal slope is approximately 2% at the bottom of the swale; low slopes reduce public hazards, limit erosion, and increase pollutant removal. Side slopes should be 3:1 (horizontal:vertical) or shallower, to limit erosion and to improve maintainability.

Plant species should be selected that can survive periods of both inundation and drought. A variety of grass species, including native and non-native, can together produce a swale turf that is adapted to varying site environments. Both trees and shrubs can be located adjacent to swales, and on the banks of larger swales, but nor within the flow path for maintenance reasons. Barrier shrubs may be used to reduce intrusion by people and domestic animals, but trees that shade the grasses should be avoided or spaced at least 20 feet apart. Supplemental irrigation may be necessary to keep turf grasses green year-round. Animal manure shall not be used as a soil amendment, and usage of fertilizers and pesticides shall be minimized.

A summary of the recommended BMPs for the senior housing (eastern) portion of the site is presented in Table 3.

Proposed project would be considered a "Group 1 Project" under Provision C.3 of the City's NPDES permit; thus, stormwater quality control measures are required.	
Total Project Site Area, Senior Housing Portion	6 acres
Proposed Impervious Area (percent)	2.75 acres (46%)
Stormwater Quality Control BMPs	Grass/Vegetated Swales Planter Boxes Infiltration
Minimum Area of Swales (if sole BMP)	3,300 square feet (0.08 acres)
Minimum Recommended Retention Volume (to retain 0.5-inch of rain)	5,000 cubic feet

Table 3: Summary of SWQCP Elements, Senior Housing Portion

RESIDENTIAL (WESTERN) PORTION ALTERNATIVES

A number of alternative configurations could occur for the residential (western) portion of the project site to meet the stormwater treatment requirements. These alternative configurations are described below.

Use of Park for Swale

Under this option, the proposed "public park" located in the northwest corner of the site could be utilized as a dual-use facility, whereby a portion of the park could also act as a stormwater treatment swale. In order to treat the runoff from the entire 10-acre residential development, the swale would need to have a minimum area of 7,600 square feet (0.17 acres) within the one-acre park site. The advantage of this option is that all stormwater treatment would occur at one facility, which would simplify maintenance requirements; this would also provide treatment just prior to the stormwater discharge to the City's storm drain system. The proposed swale could easily serve a dual use as an athletic field or other purpose.

Use of the Landscaped Open Space for Swale

The "landscaped open space" located along the northeastern perimeter of the site could be used as a stormwater treatment swale. There exists approximately 7,000 square feet of area there, which would be nearly enough to treat the entire site; however, hydraulic considerations would prevent the use of this site for treating the entire residential (western) portion. Most feasibly, drainage from a portion of the site (estimated at 20% of the 10-acre residential development) could be routed to this location for treatment, and after overland flow through the swale would be routed to a buried pipe and transported west to the City's drainage system. It is possible that this area could serve as a small stormwater detention facility as well.

Use of the Senior Housing Swale

A portion of the stormwater runoff from the residential (western) portion of the site could be routed to the swales for the senior housing (eastern) portion of the project site. This would require that the proposed swales for the senior housing portion be enlarged to accommodate runoff from the residential (western) portion of the site.

On-Site Treatment for Internal and External Lots

Internal Lots. The smaller, internal lots contain a landscaping feature that could serve a dual use for stormwater treatment. With the exception of the western-most row of units (which would drain to the street), stormwater from all of the smaller, internal units could be routed to an internal swale; from the end of the swale, the treated stormwater would be conveyed via a buried pipeline to the City's storm drain system. These swales would need to have a minimum area of 2,300 square feet to treat runoff from these residences. Assuming swales 10 feet wide, over 12,000 square feet are available within these landscaped areas around these internal lots; thus, there exists sufficient area for swales.

External Lots. The external lots are generally larger than the internal lots, with additional options for stormwater management. Two Sub-options exist for stormwater management on these sites. First, infiltration trenches could be constructed for each site. Assuming approximately 2,000 square feet of impervious surfaces per site and 0.5 inches of rain to infiltrate, approximately 80 cubic feet of stormwater would need to be infiltrated. Assuming a gravel-filled trench with a porosity of 0.2, the infiltration trench would have a required volume of approximately 400 cubic feet, or 40 feet long, 5 feet wide, and 2 feet deep, covered with 2 feet of soil for landscaping. Rainfall in excess of 0.5 inch would flow overland to the streets for conveyance in the City's system. For the 36 perimeter units, this would involve the total excavation of over 500 cubic yards of soil, and subsequent importation and backfilling with a corresponding amount of gravel. It is important to note that the feasibility of infiltration as a stormwater management technique is subject to the conducting of percolation tests on-site to determine whether the local soils would have a sufficient infiltration rate.

Second, the lots could be configured so that stormwater from rooftops and driveways would flow overland through landscaping that would serve as a treatment swale, discharging to the street system. There would be adequate space on each individual lot for a treatment swale. This would require that each homeowner maintain the system for stormwater treatment.

Mechanical Devices

The use of proprietary mechanical treatment devices would probably be most appropriate to treat runoff from the street system, as part of a variety of treatment options as described above. These devices tend to require dedicated maintenance efforts, but may be appropriate considering the constrained nature of the street system (including underground utility corridors), which prevents the use of swales adjacent to the streets.

Summary of Stormwater Quality Control Options

A summary of the alternative Stormwater Quality Control Plan elements is presented in Table 4. During final design, BMPs should be selected based on agency acceptance, technical feasibility, economic feasibility, and long-term maintenance requirements. In addition, the overall drainage conditions and stormwater quality control should be integrated throughout the entire 17-acre site, utilizing the various opportunities and constraints.

Proposed project would be considered a "Group 1 Project" under Provision C.3 of the City's NPDES permit; thus, stormwater quality control measures are required.	
Total Project Site Area, Residential Portion (incl. 1-acre park)	11 acres
Proposed Impervious Area (percent)	6.34 acres (58%)
Stormwater Quality Control BMPs	Grass/Vegetated Swales Planter Boxes Infiltration Mechanical Devices
Minimum Area of Swales (if sole BMP)	7,600 square feet (0.17 acres)
Minimum Recommended Retention Volume (to retain 0.5-inch of rain)	11,500 cubic feet

Table 4: Summary of Stormwater Quality Control Options, Residential Portion

MAINTENANCE REQUIREMENTS

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. Routine maintenance is needed to ensure that flow is unobstructed, that erosion is prevented, and that soils are held together by plant roots and are biologically active. All facility components, vegetation, and source controls shall be inspected for proper operation and structural stability, at a minimum, two times per year (including once at the start of the winter rainy season), and within 48 hours of each major storm event. The facility owner shall keep a log recording all inspection dates, observations, and maintenance activities. Typical maintenance activities include:

- Maintenance of grass swales includes mowing and removing clippings and litter, while vegetated swales may require additional maintenance of plants to maintain a healthy vegetative cover;
- Sediment accumulation needs to be periodically removed at the top of banks, in the swale bed, or behind check dams;
- Monitoring for erosion will be required, especially after heavy runoff, with control measures taken as necessary; reseeding or replanting may also be required;
- Inspect and repair (as necessary) all inlets, outlets, and side slopes;
- Abate any potential vectors by filling holes in the ground in and around the swale;
- The application fertilizers and pesticides should be kept to a minimum, with Integrated Pest Management (IPM) techniques implemented where feasible.

Planter box maintenance typically consists of the following tasks:

- Examine downspouts from rooftops and sheet flow paths from paved areas to ensure that flow is unimpeded, and removed debris and repair damaged pipes;
- Examine overflow pipe to ensure that it can convey excess flows to a storm drain, and repair or replace damaged piping;
- Check the underdrain piping to ensure that it is intact and unobstructed;
- Observe the structure of the box and repair any holes, cracks, or other failure;
- Check that the soil is at the appropriate depth, allowing one foot of reservoir above the soil surface, and remove any accumulated sediment, litter, or debris;
- Confirm that the soil is not clogging, and that the planter will drain within three to four hours after a storm event; and
- Determine whether the vegetation is dense and healthy, replace dead plants if necessary, prune overgrown plants, replenish mulch, and remove any nuisance or invasive vegetation.

Maintenance of mechanical devices would vary depending on the model selected; manufacturer's guidelines should be followed.

The City of Santa Clara will require agreements that address the long-term operation and maintenance of all stormwater BMPs on the project site.

In addition to BMP maintenance, the project sponsor shall implement additional "Good Housekeeping" BMPs as appropriate, including regular maintenance activities (*i.e.,* damp sweeping, cleaning storm water inlets, litter control, erosion control fencing) at the site to prevent soil, grease, and litter from accumulating on the project site and contaminating surface runoff. All trash and recycling storage areas shall be covered. Storm water catch basins shall be stenciled to discourage illegal dumping.

4.2 STORMWATER VOLUME

There would be a post-development increase in runoff volumes from the project site, although no significant adverse impacts to beneficial uses are anticipated as a result of the proposed project, and no additional mitigation is required under Provision C.3 because the site drainage discharges to a concrete box culvert, and subsequently flows to South San Francisco Bay; thus, the potential for increase erosion is minimal. However, the local storm drainage system may not be able to accommodate the increased runoff volumes, and local detention of stormwater may be required; this topic is addressed separately by HMH Engineers.

5. REFERENCES

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